SAND2022-5526C

LWRS LIGHT WATER REACTOR SUSTAINABILITY

Physical Security Pathway

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Overview of Physical Security Pathway

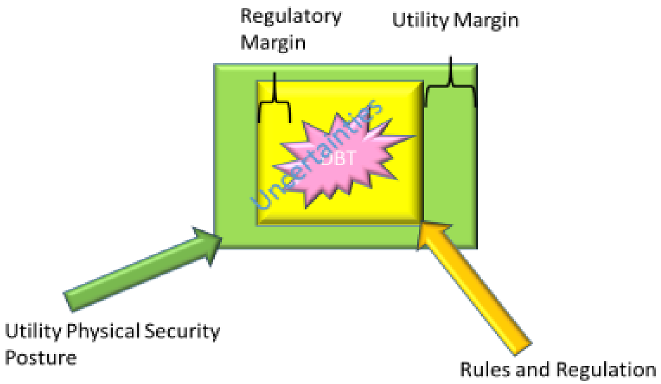
Physical Security research aims to create tools, technologies, and risk-informed physical security decisions and activities with the following objectives:

- Develop mitigation strategies and enhance the technical basis necessary for stakeholders to reevaluate physical security postures while meeting regulatory requirements.
- Analyze the existing physical security regime, current best practices, and compare/contrast insights with alternative methods which leverage advanced modeling and simulation, modern technologies, and novel techniques that address design basis threat and regulatory requirements

Short-term goal is to enable industry to operate nearer the staffing requirements of 10 CFR 73.55

Main research thrust areas:

- Advanced Security Technologies
- Risk-Informed Physical Security
- Advanced Security Sensors



FY-22 Activities

- Stakeholder Engagement Meetings
  - Path Analysis Workshop
- Advanced Security Technologies
  - Remote Operated Weapons System (ROWS)
- Risk-Informed Physical Security
  - Dynamic Risk-Informed Framework
  - Unattended Openings (UAOs)
- Advanced Security Sensors
  - Deliberate Motion Analytics (DMA)

Recent Accomplishments

- Completed first FY-22 stakeholder engagement meeting in February
- Conducted preliminary Sentry-II ROWS modeling with collaborating utilities
- Completed unattended opening testing
- Completed discussion series for developing a risk-informed security methodology with pilot utility and PWROG
- Ongoing human factors data collection during DOE marksman training evolutions
- Completed Interim Access Delay Security System Desk Reference (SSDR)
- Conducted first pilot study of DMA with collaborating utility

Industry Engagement & Roles

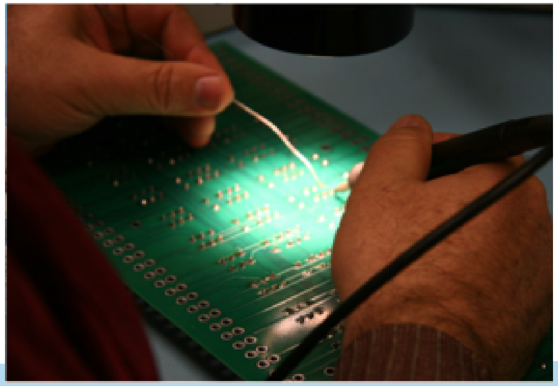
- ROWS – Xcel Energy, Entergy, Constellation, and NRC
- Unattended openings – NEI, Xcel Energy, Southern Nuclear Co. Stars Alliance, Dominion Energy, Entergy, NextEra, Exelon, and NRC
- Deliberate Motion Analytics – American Electric Power and Entergy
- Dynamic Risk-Informed Framework – Southern Nuclear, Arizona Public Service, PWROG, and RhinoCorps

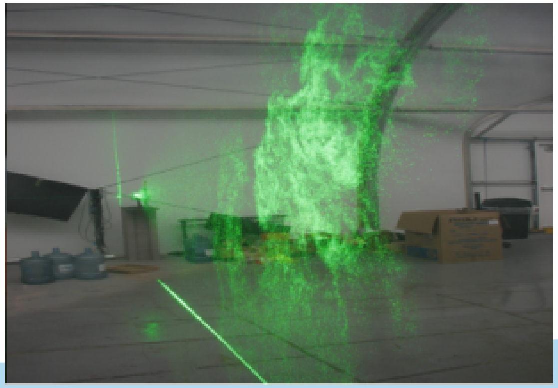
- SBIR – ARES Security Corp.
- NEUP – Ohio State University



Impactful Out-Year Outcomes (within 3-years)

- Provide the technical basis for unattended openings (2D & 3D)
- Access to updated documents from DOE Office of Security
    - Interim Access Delay SSRD, and other SSDRs
- Fleet-wide application of risk-informed access delay timelines for adversary and response force
- Support deployment of ROWS to at least one candidate site
- Pilot an integrated approach to dynamic force-on-force & reactor system response modeling
- Pilot the integration of human factors data and modeling for adversary and protective force
- Support deployment of advanced security sensor technologies
    - Sensor fusion
    - Deliberate Motion Analytics
    - Jam-proof wireless





Remote Operated Weapons System (ROWS)

Impact: Leverage an existing US Government ROWS solution for external and internal deployment at domestic nuclear power plant sites for an added force multiplier. Reductions in response force with increased survivability of overall security force are expected.

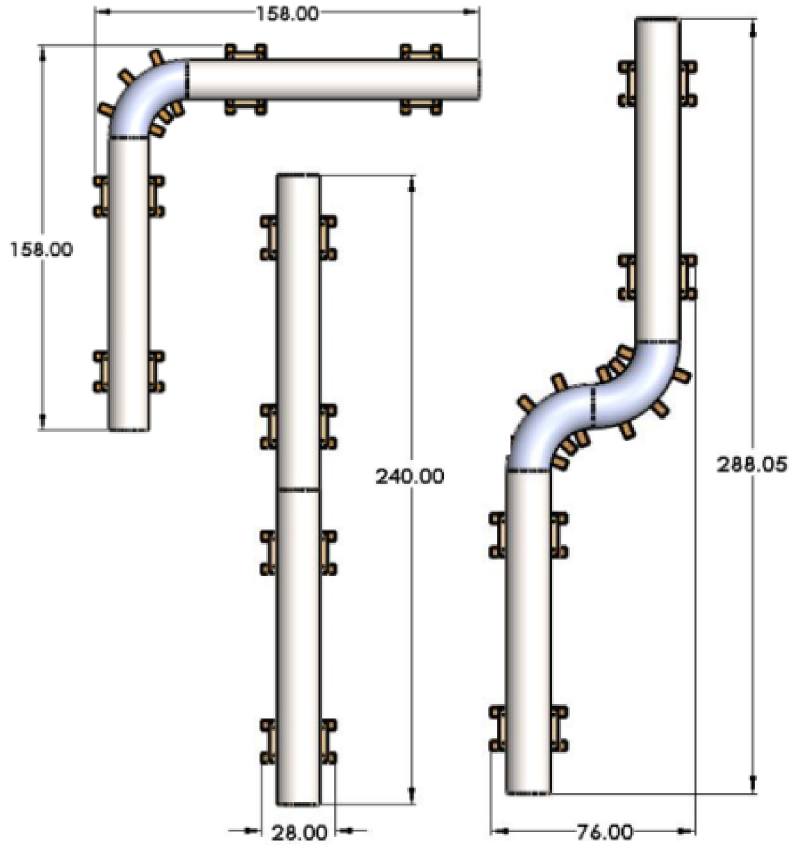
Notional Visualization for Modeling ROWS Placement

FY-22 efforts

- Preliminary Review of Sentry-II ROWS configuration
- Force-on-force modeling to inform optimized ROWS placement at a proposed pilot domestic nuclear power plant site
- Provide technical basis (security, safety, cyber, etc.) for NRC review
- Evaluate human performance data for NRC force-on-force exercise assumptions
- Evaluate the proposed 4-staged approach for ROWS deployment

Unattended Openings (UAO)

Impact: Provide the technical basis to determine optimized protective strategies related to person-passible openings that intersect security boundaries during normal and maintenance operations. Reductions in patrols, monitoring, and compensatory measures are expected but will be site specific.



Example of 3D UAO Testing Configurations

FY-22 efforts

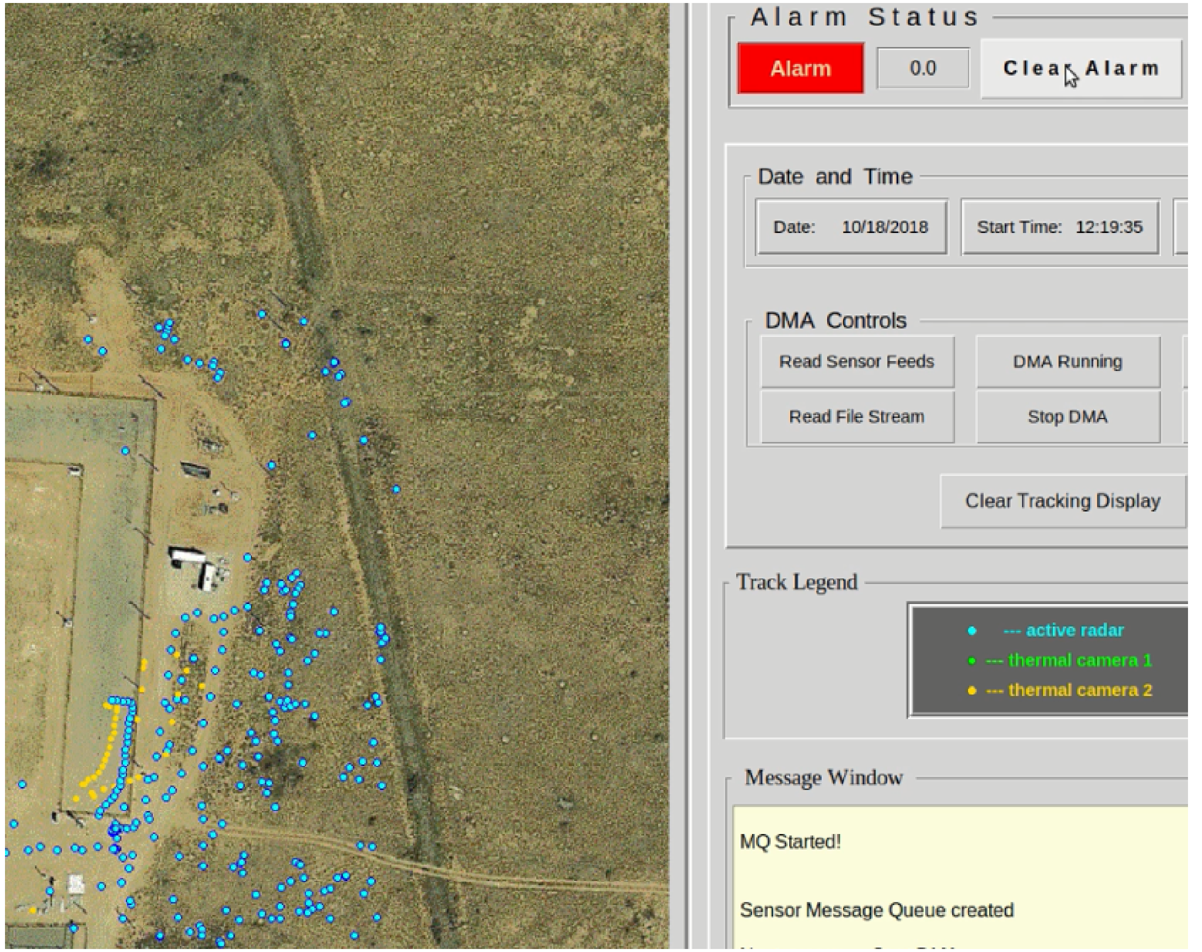
- Conduct a risk-informed evaluation for 2D and 3D unattended openings based on past US Government policy
- Identify human factors associated with 2D and 3D openings
- Evaluate 2D UAO testing with 4-inch circle & rectangles and 36-inch circle
- Evaluate 3D UAO testing with 20-foot piping sections and pipe bends
- Evaluate success of passing through the opening (go/no-go), rate times, and limited data on exertion

Deliberate Motion Analytics (DMA)

Impact: Security sensor fusion linked with DMA can take input from multiple sensors of different types, analyze the data, and determine if an adversary is making an approach toward a facility. Sites using current commercial sensor technologies typically experience elevated nuisance alarm rates (NAR) not caused by an intruder. Maintaining a low NAR while being able to detect intruders has the potential to decrease the cost of security.

FY-22 efforts

- Using DMA and sensor fusion, collect at least four weeks of continuous performance data at two nuclear power plant sites
- Consider engineered terrain (perimeter intrusion detection system) and un-engineered terrain (owner controlled area).
- Create an NPP-specific demonstration package containing sensor fusion



Active Radar (blue) and Thermal Camera (yellow) fused through DMA

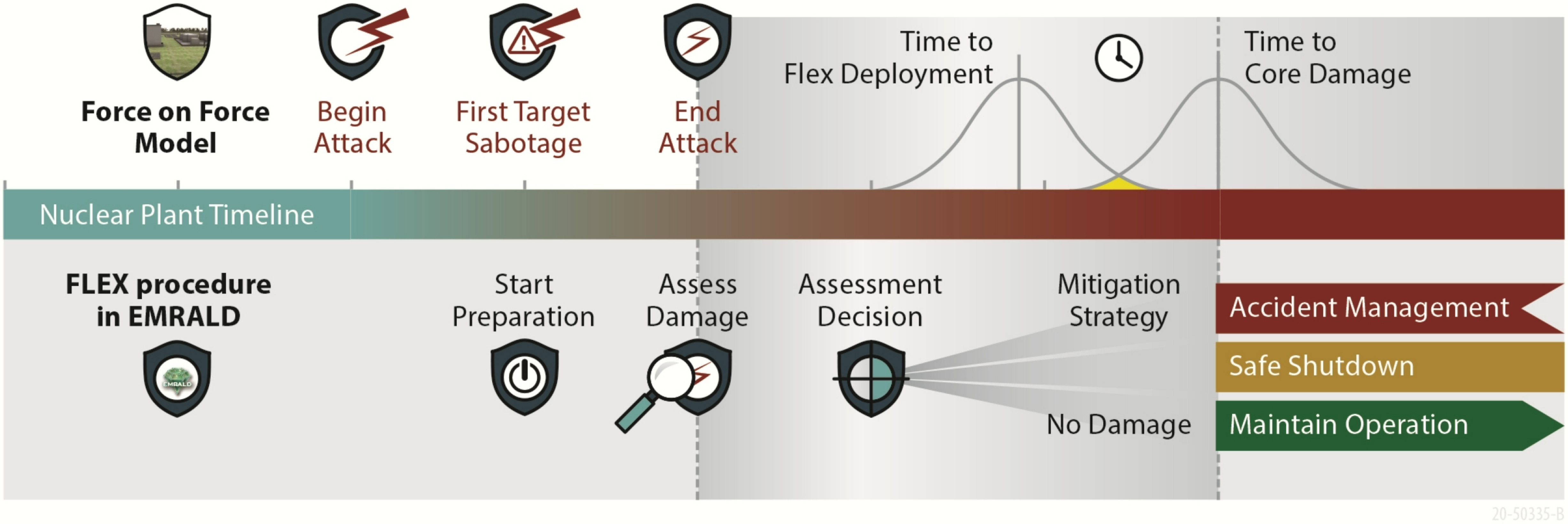
Dynamic Risk-Informed Framework

Impact: Develop and demonstrate tools for a risk-informed physical security method by integrating dynamic risk methods, physics-based modeling and simulation, operator actions, and FLEX equipment, which should extend the adversarial timeline for response force success. The tools will enable commercial utilities to incorporate increased realism in their force-on-force models, take credit for operator actions and FLEX equipment, and move toward greater use of quantitative measures of performance in security posture and the technical basis for physical security at power plants.

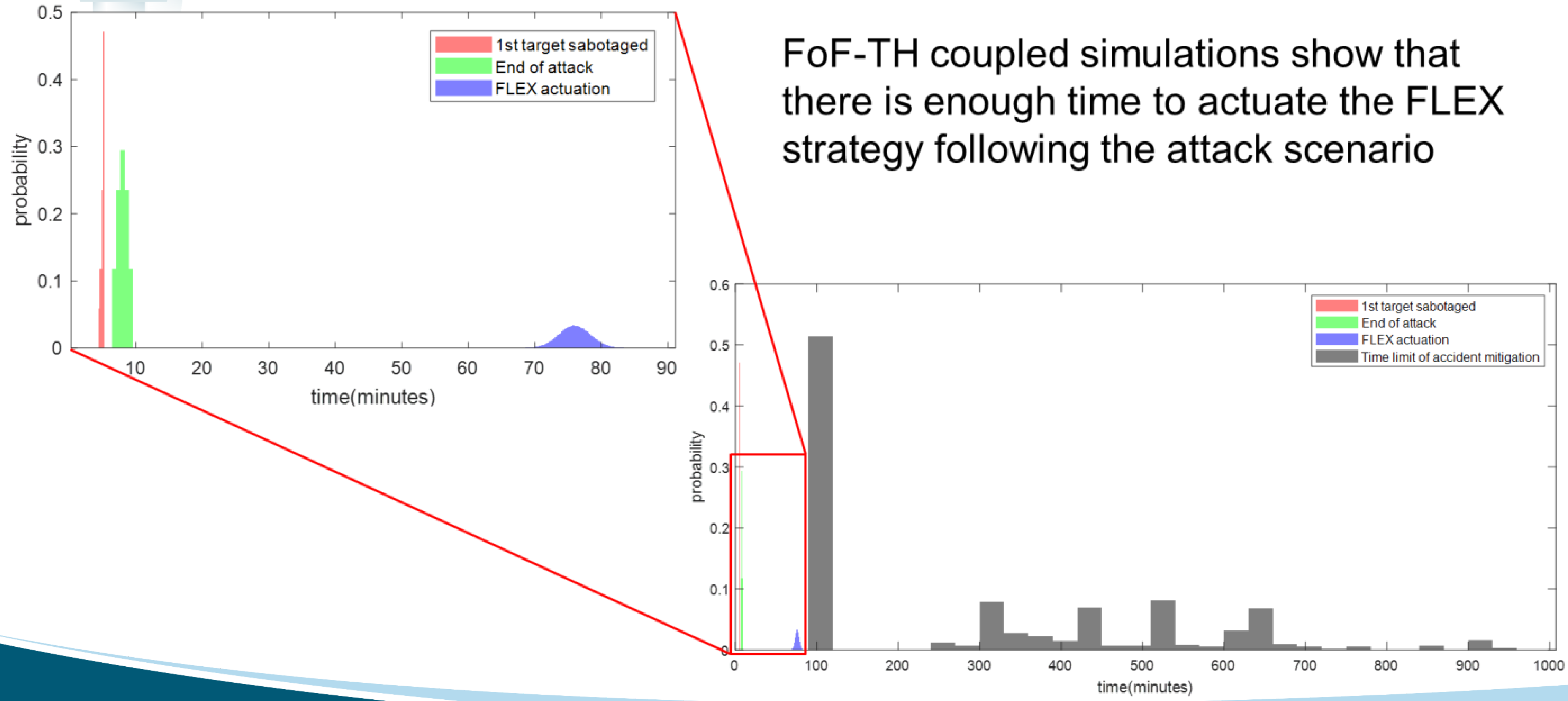
FY-22 Tasks:

- Develop guidance documents in collaboration with stakeholders to support the use of the dynamic risk tools by industry security staff with support of nuclear utility PRA staff.
- Integrate force-on-force simulation software platforms with thermal-hydraulic codes, and refine metrics for evaluation of effectiveness.
- Document Physical Security human reliability needs.
- Develop dynamic modeling tools to incorporate Force-on-Force and nuclear utility site operator actions into static and dynamic risk assessment models; credit additional operator actions and FLEX within a site's protective strategy.

Force-on-Force & FLEX Timeline Model



Realistic Core Damage Time



FoF-TH coupled simulations show that there is enough time to actuate the FLEX strategy following the attack scenario

Physical Security Research - Priority List

Research Thrust Area
Advanced Security Technologies – Remote Operated Weapons System
Advanced Security Sensors – Deliberate Motion Algorithms
Advanced Security Sensors – Water Intakes
Risk Informed Security – Dynamic Risk Framework
Advanced Security Sensors – Access/Delay for Doors to Vital Areas
Risk Informed Security – Security Economics & Risk-Informed Management for Enterprise Security

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